International Journal for Quality Research 20(1) 219–234
ISSN 1800-6450

Aktam U. Burkhanov
Elena G. Popkova[1]
Aleksandra A. Musatkina
Nilufar U. Babakhanova

Article info:
Received 18.06.2025.
Accepted 09.02.2026.

DOI – 10.24874/IJQR20.01-14

A GREEN APPROACH TO PRODUCT QUALITY RISK MANAGEMENT BASED ON CORPORATE ENVIRONMENTAL RESPONSIBILITY

Abstract: *The research aims to develop a green approach to product quality risk management in the Eurasian economy. To this end, drawing on official international statistics for 2025, the authors summarized the empirical experience of twenty green economies of Eurasia belonging to the Eastern Europe & Central Asia region. The resulting approach comprises, first, a Eurasian model of environmental risk management of product quality, which mathematically describes the dependence of environmental product quality risks on managerial factors. Second, it includes alternative forecast scenarios for changes in product quality in the green economy of Eurasia up to the completion of the Decade of Action (until the beginning of 2031), depending on the intensity of efforts to combat environmental quality risks and the managerial measures applied by organizations. On this basis, the scenario of rapid environmentalization is substantiated as preferable, while the continuation of gradual environmentalization of quality risk management in Eurasia up to 2031 is deemed undesirable. Third, the research proposes applied solutions for improving environmental product quality risk management in Eurasia, the implementation of which will accelerate the reduction of production and consumption waste and decrease industrial air pollution in Russia, Serbia, and Uzbekistan.*

Keywords: *green approach, risk management, quality management, product quality, corporate environmental responsibility, Eurasia.*

1. INTRODUCTION

Quality is the most important characteristic of a product because it determines the extent to which the product satisfies the need it is intended to meet. From the perspective of an organization as a producer and supplier or seller in the market, quality management is carried out in the interest of ensuring the product's competitiveness in terms of its marketability in that market. When substitute goods are of comparable quality, their competitiveness is determined by price.

However, under the influence of the human factor affecting consumer behavior and reducing the price elasticity of demand, a product may sell well on the market even with lower price competitiveness (i.e., at a higher price compared to competitors), while its production and sale remain a commercially attractive investment project for the organization. The primary factors limiting price elasticity of demand include the following:

[1] Corresponding author: Elena G. Popkova
Email: 210471@mail.ru

- Possession by an individual consumer of incomplete information about market offerings, preventing them from becoming aware of more attractive price conditions;
- The use by market players of pricing marketing practices that introduce confusion into price competition and complicate objective price comparisons among substitute goods, for example, due to differences in units of price measurement, as well as the psychological effect of price tags (prices expressed not as whole numbers but as fractions using nines);
- Switching costs, including financial and psychological costs (arising from loyalty programs that retain customers) and other costs (stemming from consumers' unwillingness to spend time, effort, and attention on learning about new products on the market, as well as on organizing a switch to them even when they recognize some potential benefit);
- Low price competition, in which substitute goods available on the market differ only slightly in price, making price differences insignificant for consumers and thereby leading them to prefer the stable purchase of familiar, tried-and-tested products.

Contrary to initial expectations, the spread of electronic commerce has left price elasticity of demand largely unchanged, having a significant impact only on the first of the four factors underlying its low level, by somewhat increasing consumer awareness of available market offerings and providing smart marketing analytics tools for the rapid selection of substitute goods and their comparison, considering customizable individual consumer preferences.

As a result, even in digital economic systems, product quality remains the decisive factor for competitiveness and successful sales in the target market. Under the influence of the evolution of social and business culture, the understanding of product quality, as a complex scientific and economic category, has changed. Prior to the widespread adoption of marketing-oriented quality management, quality was reduced to the technical properties of a product, on which its ability to satisfy consumers' basic needs depended.

The popularization of marketing-oriented quality management led to the artificial creation of new needs. Accordingly, product quality came to be interpreted in terms of the extent to which a product, based on its technical characteristics, satisfies artificial needs alongside or even instead of natural (basic) needs. Over time, non-technical (i.e., additional) product attributes have gained increasing importance. A typical example is an organization's concern for its employees, which is unrelated to the technical characteristics of the product or to the satisfaction of consumer needs, yet is increasingly considered by consumers when making purchasing decisions.

The green transition of contemporary economic systems has contributed to the formation of an environmental component of product quality. Among goods with similar technical characteristics and minor price differences, consumers tend to prefer products with superior environmental attributes or those supplied by companies implementing large-scale corporate environmental protection programs.

In the most advanced green socio-economic systems, products with enhanced environmental characteristics are the most competitive even when their technical and price attributes are noticeably less attractive than those of substitute goods. Therefore, in managing quality under contemporary market conditions, largely shaped by the specific context of the green economy, it is essential to ensure appealing environmental properties

of products.

A key problem lies in the underdevelopment of a scientific methodology for environmental risk management of product quality, which hinders the institutionalization of this managerial practice in the business environment and reduces its effectiveness. The complexity of addressing this problem is due to the fact that, like any institution, this practice requires adaptation to the socio-economic context, which is known to vary across geographical regions of the world. The Eurasian region, which includes the countries of Europe and Central Asia, warrants independent study because of its pronounced socio-economic specificity.

The above considerations determined the objective of this article, which is to develop a green approach to product quality risk management in the Eurasian economy, as well as a set of research tasks through which this objective is achieved. The first task is to develop a Eurasian model of environmental risk management of product quality. The second task is to identify trends in environmental risk management of product quality in the Eurasian economy and forecast the consequences of the continuation of these trends in Eurasia (using the cases of Serbia, Russia, and Uzbekistan). The third task is to formulate recommendations for improving environmental risk management of product quality in Eurasia (based on the cases of Serbia, Russia, and Uzbekistan).

2. LITERATURE REVIEW

2.1 The Fundamental Framework and Reconsideration of the Existing Approach to Product Quality Risk Management from the Perspective of the Green Economy

The fundamental basis of the research conducted in this research is formed by the scientific and theoretical concept of product quality risk management in a market economy. In a general sense, from a microeconomic perspective (that of an organization as the entity managing the quality of its products), product quality risk is understood as the emergence of undesirable product attributes that lead to negative consequences for the organization, namely a decline in its competitiveness in the target market and a reduction in sales volumes, thereby causing losses from entrepreneurial activities related to the production and sale of the product in question (Melkamu et al., 2024; Rogachev et al., 2018).

When technical characteristics are concerned, defects represent the manifestation of quality risk. The concept of the green economy offers a new perspective on product quality by adding environmental attributes to its standard technical and non-technical properties (e.g., those related to working conditions within the organization). These environmental quality attributes are associated with the use of natural resources throughout the processes of production, distribution, and consumption of products (Abdalhamid et al., 2025).

In accordance with the concept of the green economy and drawing on prior literature (Kitsai et al., 2023; Tadevosyan, 2023; Torosyan et al., 2011), this research formulates an original definition of environmental product quality risk as the emergence of undesirable environmental attributes of a product that result in negative consequences for the organization, namely a decline in its competitiveness in the target market and a reduction in sales volumes, thereby causing losses from entrepreneurial activities related to the production and sale of the product in green economy markets.

Building on this definition and guided by the published literature (Bogoviz et al., 2017; Matevosyan et al., 2024), environmental risk management of product quality in this research is understood as the implementation by an organization of managerial measures aimed at improving or maintaining (preventing deterioration of) the environmental attributes of products

manufactured and sold in green economy markets. The proposed definitions of environmental product quality, risk, and environmental risk management of product quality have shaped and clarified the conceptual framework of the research presented in this article and have clearly delineated the boundaries of its subject area.

Reconsidering the existing approach to product quality risk management from the perspective of the green economy allows the author to draw the theoretical conclusion that, in the market context of the green economy, quality management within organizations is not limited to the traditional domains of production management (control of production aimed at identifying and preventing defects), marketing management (analysis of consumer preferences and monitoring of sales), and financial management (assessment of the profitability and returns of a given product category). Rather, it extends beyond these areas to encompass environmental management as well, the essence of which lies in combating climate change and demonstrating environmental stewardship in the activities of an organization as a market participant in the green economy.

2.2 The Theoretical Basis of the Green Approach to Product Quality Risk Management and an Analysis of Gaps in the Literature

The conducted review and content analysis of the existing scholarly literature on the topic under study have outlined the theoretical basis of the green approach to product quality risk management, according to which the following three main environmental product quality risks are identified:

- The risk of an increase in (municipal solid) waste from production and consumption (Orlova et al., 2024);
- The risk of growing air pollution resulting from product manufacturing (Egnatosyan et al., 2023);
- The risk of increased air pollution caused by the import of goods (Alekseev et al., 2019; Bogoviz et al., 2018).

From a scientific and methodological perspective, it is advisable to consider differences in the ways of addressing environmental quality risks. A classification of environmental product quality risk management methods has been developed based on the criterion of flexibility of this managerial practice in the activities of an organization as a market actor in the green economy. According to the author's classification, non-flexible methods are distinguished on the one hand, the main one being environmental standardization of product quality in accordance with ISO 14001 (Drobot et al., 2024). On the other hand, flexible methods are identified, including green investments (Popkova & Abdurakhmanova, 2024), green trade (Grigoryan et al., 2024; Sngryan, 2022), green employment (Galoyan et al., 2023; Hayrapetyan & Isayan, 2022), and green innovations (Konina, 2024).

The advantage of the proposed new classification lies in its consideration of a poorly studied yet significant factor for environmental product quality risk management, namely, the initiative of organizations as market agents in the green economy. Accounting for this factor makes it possible to better understand the institutional nature of addressing environmental product quality risks in the economic and managerial activities of organizations.

The analysis of gaps in the published scholarly literature revealed a lack of knowledge regarding the contribution of various managerial methods related to the green economy to overcoming environmental risks (threats) to product quality in the specific market context of Eurasia, whose experience has been examined only in isolated academic studies (Bogoviz et al., 2019, 2023; Gyiazov et al., 2023; Tovmasyan, 2022).

The need to fill the identified gap in the literature is explained by the fact that the methods distinguished in the proposed classification are alternative (mutually exclusive). Organizations either follow standards, thereby excluding any independence, or adopt a creative approach to combating environmental product quality risks.

Since combining different methods (flexible and non-flexible) is impossible, a choice must be made in favor of one of them. However, the necessary scientific and methodological foundation for such a choice has not yet been formed. Therefore, this research poses the research question of which methods (non-flexible (environmental standardization) or flexible (green investments, green trade, green employment, and green innovations)) are most effective in addressing environmental product quality risks in the activities of Eurasian organizations. The research seeks to fill the identified gap in the literature and is devoted to finding an answer to this research question by establishing causal relationships in environmental product quality risk management in the activities of Eurasian organizations.

3. MATERIALS AND METHODS

3.1 Research Sample

The sample of this study (presented in Table 1) includes twenty green economies of Eurasia classified by GGGI (2026) as belonging to the "Eastern Europe & Central Asia" region.

Table 1. Environmental risk management of product quality in the Eurasian green economy in 2025

Eurasian green economy	Municipal solid waste, kg/capita/day	Production-based air pollution, DALYs per 1000 population	Air pollution associated with imports, DALYs per 1000 population	ISO 14001 environment, bln PPP$ GDP	Green investment, score 0–100	Green trade, score 0–100	Green employment, score 0–100	Green innovation, score 0–100
	$EvRk_1$	$EvRk_2$	$EvRk_3$	GRMs	$GRMf_1$	$GRMf_2$	$GRMf_3$	$GRMf_4$
Albania	1.054	7.071	3.508	5.90	11.15	62.01	22.80	22.90
Armenia	0.526	2.247	3.837	0.10	13.85	68.20	37.09	20.63
Azerbaijan	0.826	3.939	4.952	0.60	14.41	67.65	31.96	30.68
Belarus	1.297	13.059	3.516	1.90	14.89	69.50	19.66	3.07
Bosnia and Herzegovina	1.068	17.309	2.959	4.00	30.89	62.84	36.31	16.08
Bulgaria	1.166	20.531	5.088	11.90	25.02	78.09	35.38	23.86
Croatia	1.229	8.306	6.224	8.00	15.87	66.02	52.96	17.12
Cyprus	1.756	7.931	15.011	5.00	5.59	68.49	15.00	32.25
Georgia	0.664	4.164	3.550	0.30	20.45	69.95	37.02	26.57
Kazakhstan	0.849	9.161	3.910	0.30	13.93	62.37	12.48	16.88
Kyrgyz Republic	0.534	3.582	1.772	0.10	0.00	39.10	13.45	21.40
Malta	1.918	4.038	15.504	2.20	23.22	40.69	24.91	23.92
Moldova	3.528	6.149	2.569	0.40	0.00	0.00	14.45	11.93
North Macedonia	0.853	8.906	3.418	7.80	0.00	0.00	0.00	0.00
Romania	0.779	14.250	5.225	9.20	23.68	76.59	43.74	18.32
Russian Federation	1.198	9.988	3.039	0.10	11.34	53.72	39.15	23.18
Serbia	0.937	0.000	4.951	11.00	21.46	64.10	37.12	17.46
Tajikistan	0.641	2.882	0.872	0.00	14.50	51.50	14.87	34.23
Turkmenistan	0.313	5.672	3.493	0.00	0.00	50.52	0.00	20.42
Uzbekistan	0.419	3.483	1.244	4.20	15.21	51.35	14.14	17.83

Source: Developed by the authors based on GGGI (2026), UNDP (2026), and WIPO (2026).

The study period is 2025. In the econometric analysis, the dependent variables are the following indicators characterizing environmental risks to product quality and calculated by UNDP (2026):

- The volume of municipal solid waste from production and consumption ($EvRk_1$);
- The volume of air pollution associated with production activities ($EvRk_2$);
- The volume of air pollution resulting from imports ($EvRk_3$).

The independent variables are as follows:

- The monetary value of products subject to environmental quality standardization in accordance with ISO 14001 (GRMs), reflecting the prevalence of non-flexible environmental risk management methods among organizations, as calculated by WIPO (2026);
- The level of development of green investments (GRMf1), green trade (GRMf2), green employment (GRMf3), and green innovations (GRMf4), demonstrating the prevalence of flexible environmental risk management methods among organizations, as calculated by GGGI (2026).

The data from Table 1 formed the statistical basis for the empirical study conducted in this research.

3.2. Research Design and Methodology

The first research task (i.e., to develop a Eurasian model of environmental product quality risk management) is addressed using regression analysis. To construct the required economic and mathematical model, the authors estimated the regression dependence of each of the three indicators characterizing environmental product quality risks ($EvRk_{1-3}$) on the full set of five explanatory variables (GRMs, $GRMf_{1-4}$). A reduction in risks is indicated by negative values of the regression coefficients (b_{1-5}) in the research model (1):

$$EvRk=a+b_1GRMs+b_2GRMf_1+b_3GRMf_2+b_4GRMf_3+b_5GRMf_4 \quad (1)$$

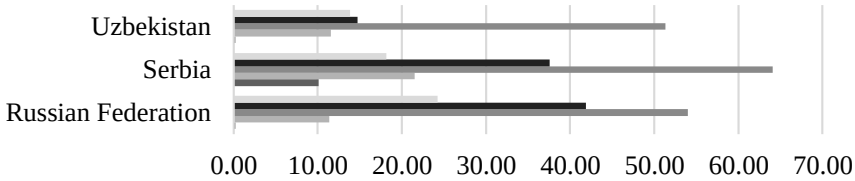
In accordance with research model (1), the set of explanatory variables whose regression coefficients take negative values is identified. Within this set, the regression coefficients of variables related to non-flexible and flexible environmental quality risk management methods are compared. The variables with the lowest regression coefficients are selected, either GRMs or those among $GRMf_{1-4}$ included in the set.

The research is then conducted using the cases of three specific Eurasian countries selected based on the geographical location of their territories: Serbia, whose territory lies entirely in Europe; Russia, part of whose territory is located in Europe and part in Asia; and Uzbekistan, whose territory lies entirely in Asia. A scenario analysis is carried out, within which two alternative scenarios for addressing environmental product quality risks in the activities of Eurasian organizations are developed based on these three countries.

The gradual environmentalization scenario assumes the preservation, over the subsequent five-year period, until the end of the Decade of Action (up to the end of 2030, i.e., the beginning of 2031), namely in 2026–2031, of the trends observed during the immediately preceding five-year period (2020–2025) with regard to the intensity of efforts to address environmental risks in organizational activities. The rapid environmentalization scenario assumes a substantial intensification of such efforts and their concentration on the management approaches most effective in overcoming environmental product quality risks in Eurasia.

The second research task (i.e., to identify trends in environmental product quality risk management in the Eurasian economy and forecast the consequences of the continuation of these trends) is addressed using trend analysis. Five-year trends are calculated (as

the ratio of indicator values in 2025 from Table 1 to their archival values in 2020 from Figure 1) for the explanatory variables GRMs and $GRMf_{1-4}$ in Serbia, Russia, and Uzbekistan.



	Russian Federation	Serbia	Uzbekistan
Green innovation, score 0–100	24.26	18.16	13.85
Green employment, score 0–100	41.86	37.59	14.70
Green trade, score 0–100	53.98	64.04	51.34
Green investment, score 0–100	11.39	21.50	11.57
ISO 14001 environment, bln PPP$ GDP	0.20	10.10	0.20

Figure 1. Environmental risk management of product quality in Serbia, Russia, and Uzbekistan in 2020. Source: Developed by the authors based on GGGI (2026) and WIPO (2026).

Based on the identified trends, forecast values of the indicators GRMs and $GRMf_{1-4}$ for 2031 are determined and substituted into research model (1), thereby revealing the expected consequences of the gradual environmentalization of product quality risk management in Eurasian organizations under the corresponding scenario.

The third research task, embodied in the formulation of recommendations for improving environmental product quality risk management in Eurasia, is addressed using the method of econometric optimization. The minimum values of $EvRk_{1-3}$ are identified across the entire sample presented in Table 1. In accordance with research model (1), for each of the three selected case countries (Serbia, Russia, and Uzbekistan), an optimal combination of the selected explanatory variables is automatically determined such that, according to the forecast up to 2031, minimal environmental product quality risks will be achieved in that country. In this way, the rapid environmentalization scenario for product quality risk management in Eurasian organizations is constructed.

4. RESULTS

4.1 Eurasian Model of Environmental Risk Management for Product Quality

To address the first research task and develop a Eurasian model of environmental product quality risk management, a regression analysis of the statistics presented in Table 1 was conducted. The resulting economic and mathematical model (2), formulated as a system of multiple linear regression equations, reflects the dependence of environmental product quality risks ($EvRk_{1-3}$) on managerial factors (GRMs and $GRMf_{1-4}$).

$$\begin{cases} EvRk_1=1.7413+0.0034GRMs+0.0033GRMf_1-0.0241GRMf_2+0.0179GRMf_3+0.0079GRMf_4 \\ EvRk_2=6.4507+0.2834GRMs+0.1576GRMf_1+0.0664GRMf_2-0.0465GRMf_3-0.2265GRMf_4 \\ EvRk_3=1.2663+0.2666GRMs+0.0424GRMf_1-0.0168GRMf_2-0.0239GRMf_3+0.1722GRMf_4 \end{cases} \quad (2)$$

According to model (2), in the green economy of Eurasia, environmental standardization of product quality in accordance with ISO 14001 does not make it possible to reduce any of the environmental product quality risks; that is, the non-flexible approach to environmental quality management proves to be ineffective. Similarly, green investments do not ensure a reduction in any of the environmental product quality risks in Eurasia, meaning that this flexible managerial approach is also ineffective.

Additional tests revealed that the equation for EvRk3 is statistically insignificant, as it failed the Fisher F-test (F significance = 0.7761; observed F = 0.4933). This indicates that the risk of increased air pollution caused by product imports is not amenable to management in the activities of Eurasian organizations.

The remaining two regression equations proved to be statistically significant: the equation for $EvRk_1$ at a significance level of 0.40 (F significance = 0.3556; observed F = 1.2075), and the equation for $EvRk_2$ at a significance level of 0.35 (F significance = 0.3060; observed F = 1.3349). Based on the calculated correlation coefficients, taken together, all five managerial factors (GRMs and $GRMf_{1-4}$) explain 54.89% of the variation in the volume of production and consumption waste and 56.82% of the variation in the volume of production-related air pollution in the Eurasian economy.

An increase in the level of development of green trade in the Eurasian economy by one point contributes to a reduction in the volume of production and consumption waste by 0.0241 kg/capita/day, while simultaneously increasing the volume of production-related air pollution by 0.0664 DALYs per 1000 population.

An increase in the level of development of green employment in the Eurasian economy by one point leads to a decrease in the volume of production-related air pollution by 0.0465 DALYs per 1000 population, while increasing the volume of production and consumption waste by 0.0179 kg/capita/day.

An increase in the level of development of green innovations in the Eurasian economy by one point is accompanied by a reduction in the volume of production-related air pollution by 0.2265 DALYs per 1000 population, while increasing the volume of production and consumption waste by 0.0079 kg/capita/day.

4.2. Trends for 2020–2025 and the Gradual Environmentalization Scenario for Product Quality Risk Management in Eurasia for 2026–2031

To address the second research task and identify trends in environmental product quality risk management in the Eurasian economy, a trend analysis of statistics for the explanatory variables (GRMs and $GRMf_{1-4}$) in Serbia, Russia, and Uzbekistan was conducted using data from Table 1 and Figure 1. The following five-year trends were identified.

In Russia, a trend toward a reduction in the monetary value of products subject to environmental quality standardization in accordance with ISO 14001 by a factor of 0.50 was identified (from 0.20 bn PPP$ GDP in 2020 to 0.10 bn PPP$ GDP in 2025), along with a decline in activity in green investments by a factor of 0.996 (from 11.39 points in 2020 to 11.34 points in 2025), in green trade by a factor of 0.995 (from 53.98 points in 2020 to 53.72 points in 2025), in green employment by a factor of 0.935 (from 41.86

points in 2020 to 39.15 points in 2025), and in green innovations by a factor of 0.955 (from 24.46 points in 2020 to 23.18 points in 2025).

In Serbia, a trend of growth in the monetary value of products subject to environmental quality standardization in accordance with ISO 14001 by a factor of 1.089 was identified (from 10.10 bn PPP$ GDP in 2020 to 11.00 bn PPP$ GDP in 2025), along with a decline in activity in green investments by a factor of 0.998 (from 21.50 points in 2020 to 21.46 points in 2025), an increase in green trade activity by a factor of 1.001 (from 64.04 points in 2020 to 64.10 points in 2025), a decrease in green employment activity by a factor of 0.987 (from 37.59 points in 2020 to 37.12 points in 2025), and a decline in green innovation activity by a factor of 0.961 (from 18.16 points in 2020 to 17.46 points in 2025). In Uzbekistan, a trend of a sharp increase in the monetary value of products subject to environmental quality standardization in accordance with ISO 14001 by a factor of 21 was identified (from 0.20 bn PPP$ GDP in 2020 to 4.20 bn PPP$ GDP in 2025), along with growth in green investment activity by a factor of 1.315 (from 11.57 points in 2020 to 15.21 points in 2025), an increase in green trade activity by a factor of 1.0002 (from 51.34 points in 2020 to 51.35 points in 2025), a reduction in green employment activity by a factor of 0.962 (from 14.70 points in 2020 to 14.14 points in 2025), and growth in green innovation activity by a factor of 1.287 (from 13.85 points in 2020 to 17.83 points in 2025). Based on the identified trends, forecast values of the indicators GRMs and $GRMf_{1–4}$ for 2031 were determined as the products of their 2025 values in Russia, Serbia, and Uzbekistan and the corresponding trend coefficients. The resulting forecast values were substituted into model (2), thereby establishing the expected consequences of the gradual environmentalization of product quality risk management in Eurasian organizations under the corresponding scenario (Figure 2).

	ISO 14001 environment	Green investment	Green trade	Green employment	Green innovation	Municipal solid waste	Production-based air pollution
Russian Federation	-50.00	-0.44	-0.48	-6.47	-4.45	-3.17	-3.48
Serbia	8.91	-0.19	0.09	-1.25	-3.85	-0.75	0.00
Uzbekistan	2000.00	31.46	0.02	-3.81	28.74	26.49	263.48

Figure 2. Forecast of changes (by 2025) in environmental risk management quality indicators until 2031 under a gradual greening scenario, %. Source: Developed by the authors.

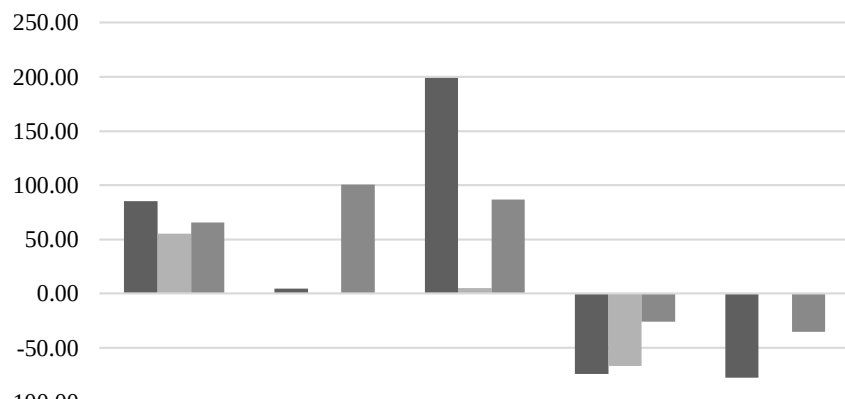
As shown in Figure 2, under the gradual environmentalization scenario for Eurasian product quality risk management, by 2031, the volume of production and consumption waste is projected to decrease by 3.17% (compared to 2025) in Russia (to 1.16 kg/capita/day) and 0.75% in Serbia (to 0.93 kg/capita/day) while increasing by 26.49% in Uzbekistan (to 0.53 kg/capita/day). Simultaneously, by 2031, a reduction in production-related air pollution is expected in Russia by 3.48% (to 9.64 DALYs per 1000 population). In turn, in Uzbekistan, this indicator is projected to increase by 263.48% (reaching 12.66 DALYs per 1000 population).

4.3 The Rapid Environmentalization Scenario for Product Quality Risk Management in Eurasia up to 2031

To address the third research task and formulate recommendations for improving environmental product quality risk management in Eurasia, the authors identified the minimum values of $EvRk_{1\text{-}2}$ across the entire sample from Table 1: the volume of production and consumption waste (0.31 kg/capita/day) and the volume of production-related air pollution in Russia (2.25 DALYs per 1000 population).

Based on model (2), for each of the three selected case countries (Serbia, Russia, and Uzbekistan), an optimal combination of the selected explanatory variables ($GRMf_{2\text{-}4}$), was identified through an automated selection procedure, under which minimal environmental product quality risks are projected to be achieved in each country by 2031.

In this way, a rapid environmentalization scenario for product quality risk management in Eurasian organizations was developed, assuming a substantial intensification of this managerial activity and its concentration on the management approaches most effective in overcoming environmental product quality risks in Eurasia (Figure 3).



	Green trade	Green employment	Green innovation	Municipal solid waste	Production-based air pollution
Russian Federation	85.29	4.73	198.92	-74.12	-77.47
Serbia	55.12	0.73	5.04	-66.92	
Uzbekistan	65.39	100.50	86.88	-26.01	-35.40

Figure 3. Forecast of changes (by 2025) in environmental risk management quality indicators until 2031 under a scenario of rapid greening, %. Source: Developed by the authors.

As shown in Figure 3, under the rapid environmentalization scenario for Eurasian product quality risk management, by 2031, the volume of production and consumption waste will be reduced by 74.12% in Russia (compared to 2025), 66.92% in Serbia, and 26.01% in Uzbekistan. Simultaneously, by 2031, a reduction in production-related air pollution will be achieved by 77.47% in Russia and 35.40% in Uzbekistan. To implement this scenario in practice, the following is recommended by 2031 (compared to 2025):

- Activity in the green trade should be increased by 85.29% (to 99.54 points) in Russia, 55.12% (to 99.43 points) in Serbia, and 65.39% (to 84.93 points) in Uzbekistan;
- Activity in green employment should be increased by 4.73% (to 41.00 points) in Russia, 0.73% (to 37.39 points) in Serbia, and 100.50% (to 28.35 points) in Uzbekistan;
- Activity in green innovations should be increased by 198.92% (to 69.29 points) in Russia, 5.04% (to 18.34 points) in Serbia, and 86.88% (to 33.32 points) in Uzbekistan.

5. DISCUSSION

The research contributes to the literature of Abdalhamid et al. (2025), Bogoviz et al. (2017), Egnatosyan et al. (2023), Kitsai et al. (2023), Matevosyan et al. (2024), Melkamu et al. (2024), Orlova et al. (2024), Rogachev et al. (2018), Tadevosyan (2023), and Torosyan et al. (2011) by further developing the scientific and theoretical concept of product quality risk management in a market economy. Specifically, it clarifies the contribution of various managerial approaches associated with the green economy to overcoming environmental risks (threats) to product quality in the distinctive market context of Eurasia (Table 2), thereby filling an identified gap in the literature.

Table 2. A green approach to product quality risk management in Eurasia compared with the literature reflecting international experience

Methods of environmental risk management for product quality (in their authors' classification)		Literature describing these methods	The contribution of these methods to combating quality risks
Inflexible approach	Product quality standardization in accordance with ISO 14001	Drobot et al. (2024)	absent
Flexible approach	Green investments	Popkova and Abdurakhmanova (2024)	absent
	Green trade	Grigoryan et al. (2024), Sngryan (2022)	reduces the risk of increasing waste
	Green employment	Galoyan et al. (2023), Hayrapetyan and Isayan (2022)	reduces the risk of increased air pollution from production
	Green innovations	Konina (2024)	

Source: Developed by the authors.

As follows from Table 2, contrary to Drobot et al. (2024), it is established that non-flexible managerial methods (chief among them environmental standardization of product quality in accordance with ISO 14001) are ineffective in addressing environmental product quality risks in contemporary Eurasia. The contribution of flexible managerial methods to this effort is highly differentiated. In contrast to Popkova and Abdurakhmanova (2024), it is shown that in Eurasia, such a flexible method as green investments does not reduce environmental product quality risks.

The remaining flexible managerial methods reduce not all, but only certain environmental product quality risks in the Eurasian green economy. Green trade reduces only the risk of growth in municipal solid waste from production and consumption (in contrast to Grigoryan et al. (2024) and Sngryan (2022)), while green employment (in contrast to Galoyan et al. (2023) and Hayrapetyan and Isayan (2022)) and green innovations (in contrast to Konina (2024)) reduce only the risk of increased air pollution resulting from production.

In contrast to Alekseev et al. (2019) and Bogoviz et al. (2018), it is demonstrated that in Eurasia, the risk of increased air pollution caused by imports is not amenable to management within organizational activities. Thus, the scientific and methodological developments presented in this research extend the line of research by Bogoviz et al. (2019, 2023), Gyiazov et al. (2023), and Tovmasyan (2022) on environmental product quality risks in the specific market context of the Eurasian green economy and encourage future research in this field.

6. CONCLUSION

Thus, the authors achieved the stated research objective and developed a green approach to product quality risk management in the Eurasian economy, comprising the following elements:

1. A Eurasian model of environmental product quality risk management that mathematically describes the dependence of environmental product quality risks on managerial factors;
2. The results of environmental risk monitoring of product quality in Eurasian organizations, embodied in the form of five-year trends for 2020–2025;
3. Alternative forecast scenarios for changes in product quality in the green economy of Eurasia up to the completion of the Decade of Action (until the beginning of 2031), depending on the intensity of efforts to combat environmental quality risks and on the managerial measures applied by organizations;
4. Applied solutions for improving environmental product quality risk management in Eurasia.

The theoretical significance of this research lies in the developed classification of methods of environmental product quality risk management based on the criterion of flexibility of this managerial practice in the activities of organizations as market actors in the green economy. Within this framework, the ineffectiveness of non-flexible methods (environmental standardization of product quality in accordance with ISO 14001) and the preference for flexible quality management methods in Eurasia are substantiated.

The final authorial conclusion summarizing the results of this article is that the green approach to product quality risk management in the Eurasian economy should be based on corporate environmental responsibility, the most promising managerial practices of which are green trade, green employment, and green innovations.

The practical significance of the proposed scientific and practical recommendations for improving environmental product quality risk management in Russia, Serbia, and Uzbekistan lies in the fact that their implementation will help significantly accelerate the reduction of production and consumption waste and decrease production-related air pollution in Russia and Serbia, as well as curb the growth of such waste and pollution in Uzbekistan and ensure their steady decline in the period up to 2031.

References:

Abdalhamid, R. H., Salem, H. A., Metwalli, M. Z., Difalla, S. A., & Alhaggan, A. M. (2025). Effect of forward-looking disclosure about environmental sustainability accounting information on earning quality: Evidence from financial analysts forecasts in Saudi Arabia. *International Journal for Quality Research*, *19*(4), 1343-1366. DOI: 10.24874/IJQR19.04-21

Alekseev, A. N., Lobova, S. V., Bogoviz, A. V., & Ragulina, Y. V. (2019). Digitalization of the Russian energy sector: State-of-the-art and potential for future research. *International Journal of Energy Economics and Policy*, *9*(5), 274-280. DOI: 10.32479/ijeep.7673

Bogoviz, A. V., Lobova, S. V., Ragulina, Y. V., & Alekseev, A. N. (2018). A critical review of Russia's energy efficiency policies in agriculture. *International Journal of Energy Economics and Policy*, *8*(3), 67-75.

Bogoviz, A. V., Lobova, S. V., Ragulina, Y. V., & Alekseev, A. N. (2017). A comprehensive analysis of energy security in the member states of the Eurasian Economic Union, 2000-2014. *International Journal of Energy Economics and Policy*, *7*(5), 93-101.

Bogoviz, A. V., Sandu, I. S., Demishkevich, G. M., & Ryzhenkova, N. E. (2019). Economic aspects of formation of organizational and economic mechanism of the innovational infrastructure of the EAEU countries' agro-industrial complex. *In: Popkova, E., Ostrovskaya, V. (Eds.), Perspectives on the use of new information and Communication Technology (ICT) in the modern economy* (pp. 108-117). Cham, Switzerland: Springer. DOI: 10.1007/978-3-319-90835-9_13

Bogoviz, A. V., Tolmachev, A. V., Sozinova, A. A., & Gyiazov, A. T. (2023). The leading experience of ESG management of business in support of decarbonisation and development of the green economy in the Eurasian Economic Union (EAEU). In E. G. Popkova, & B. S. Sergi (Eds.), *ESG management of the development of the green economy in Central Asia.* (pp. 145-153). Cham, Switzerland: Springer. DOI: 10.1007/978-3-031-46525-3_16

Drobot, E., Petrenko, Y., Hajduk, L., & Bencic, S. (2024). The concept of business ethics circles in the context of sustainable development. *Journal of Infrastructure Policy and Development*, *8*(7), 5162. DOI: 10.24294/jipd.v8i7.5162

Egnatosyan, S., Avetisyan, A., & Khachikyan, S. (2023). Zero net energy building design as the way to increase the energy security of Armenia. *E3S Web of Conferences*, *420*, 07021. DOI: 10.1051/e3sconf/202342007021

Galoyan, D. R., Mayilyan, F. N., Bazinyan, Y. A., Movsisyan, M. E., & Torosyan, A. A. (2023). Triple exploitation of human capital in developing countries. In E. G. Popkova, & B. S. Sergi (Eds.), *ESG management of the development of the green economy in Central Asia* (pp. 375-383). Cham, Switzerland: Springer. DOI: 10.1007/978-3-031-46525-3_40

GGGI. (2026). *Green growth 2024: Index and simulation by country.* Retrieved from https://ggindex-simtool.gggi.org/SimulationDashBoard/country-profile (Accessed 9 January 2026)

Grigoryan, K., Khachikyan, S., Avetisyan, A., & Egnatosyan, S. (2024). International north-south transport corridor: New economic and trade opportunities for India and Armenia. *E3S Web of Conferences*, *549*, 06002. DOI: 10.1051/e3sconf/202454906002

Gyiazov, A. T., Isakov, N. Z., Kyzy, Z. A., & Darkenbaev, T. S. (2023). Practical experience of climate-responsible business in the digital economy markets in the Eurasian Economic Union (EAEU). In E. G. Popkova (Ed.), *Smart green innovations in industry 4.0* (pp. 77-83). Cham, Switzerland: Springer. DOI: 10.1007/978-3-031-45830-9_9

Hayrapetyan, A., & Isayan, L. (2022). Social capital and its changes in Armenia: Challenges and expectations. *Journal of Liberty and International Affairs*, *8*(1), 81-97. DOI: 10.47305/JLIA2281081h

Kitsai, J. A., Karpushova, S. E., Petrenko, E. S., & Smetanina, A. I. (2023). Social entrepreneurship as an institute of sustainable development risk management. In E. G. Popkova (Ed.), *Sustainable development risks and risk management* (pp. 363-367). Cham, Switzerland: Springer. DOI: 10.1007/978-3-031-34256-1_63

Konina, O. V. (2024). Improving business innovation management through artificial intelligence. *Journal of Trends and Challenges in Artificial Intelligence*, *1*(1), 21-32. DOI: 10.61552/JAI.2024.01.003

Matevosyan, A., Grigoryan, A., Khachatryan, M., Matevosyan, M., Israyelyan, S., & Hovakanyan, L. (2024). The recommended approach to eps risk factor assesment. *Journal of Lifestyle and SDGs Review*, *5*(1), e03015. DOI: 10.47172/2965-730X.SDGsReview.v5.n01.pe03015

Melkamu, M., Fisseha, T., & Dugassa, E. (2024). Maximization profit of agricultural crop production through decision making application. *Journal of Trends and Challenges in Artificial Intelligence*, *1*(2), 51-60. DOI: 10.61552/JAI.2024.02.002

Orlova, O. P., Sharonova, A. D., Sergeeva, I. G. Margarjan, A. Sh. Bagaeva, I. V., & Klochkova, A. V. (2024). Implementation of the cluster approach with digital tools for waste recycling in St. Petersburg and the Leningrad Region. In E. de la Poza, & S. E. Barykin (Eds.), *Navigating digital transformation: Original research across smart cities, sustainable development and beyond* (pp. 151-172). Hauppauge, NY: Nova Science Publishers, Inc.

Popkova, E. G., & Abdurakhmanova, G. K. (2024). The prospects for developing green supply chains based on implementing environmental technologies and responsible innovations in sustainable cooperation. In E. G. Popkova, O. V. Kaurova, & A. N. Maloletko (Eds.), *Sustainable cooperation for the creation of green supply chains based on environmental technologies and responsible innovations* (pp. 3-12). Cham, Switzerland: Springer. DOI: 10.1007/978-3-031-70962-3_1

Rogachev, A. F., Ostrovskaya, V. N., Natsubidze, A. S., Litvinova, T. N., & Yakovleva, E. A. (2018). Tools for sustainability management of socio-ecological systems in the Globalizing world. In E. Popkova (Ed.), *The impact of information on modern humans* (pp. 241-247). Cham, Switzerland: Springer. DOI: 10.1007/978-3-319-75383-6_31

Sngryan, S. (2022). Assessing the effects of trade liberalization with third countries: The case of the Eurasian Economic Union. *Journal of Liberty and International Affairs*, *8*(2), 35-46. DOI: 10.47305/JLIA2282035s

Tadevosyan, R. (2023). Innovations and international competitiveness: Countrylevel evidence. *Economics and Sociology*, *16*(3), 248-260. DOI: 10.14254/2071-789X.2023/16-3/13

Torosyan, G., Matevosyan, G., & Harutyunyan, S. (2011). Use of natural materials for wastewater treatment & improvement of water quality. In P. Hlavinek, I. Winkler, J. Marsalek, & I. Mahrikova (Eds.), *Advanced water supply and wastewater treatment: A road to safer society and environment* (pp. 171-180). Dordrecht, Netherlands: Springer. DOI: 10.1007/978-94-007-0280-6_15

Tovmasyan, G. (2022). Evaluating the role of tourism in the economic development of the republic of Armenia and other member states of the Eurasian Economic Union. *Journal of Liberty and International Affairs*, *8*(3), 83-98. DOI: 10.47305/JLIA2283083t

UNDP. (2026). *The Sustainable Development Goals Report 2025*. New York, NY: United Nations Publication. Retrieved from https://desapublications.un.org/publications/sustainable-development-goals-report-2025 (Accessed 9 January 2026)

WIPO. (2026). *Global Innovation Index 2025: Innovation in the face of uncertainty*. Retrieved from https://www.wipo.int/web-publications/global-innovation-index-2025/en/index.html (Accessed 9 January 2026)

Aktam U. Burkhanov
Alfraganus University, Tashkent, Uzbekistan;
National University of Uzbekistan named after Mirzo Ulugbek, Tashkent, Uzbekistan
burxanov.a@afu.uz
a.burkhanov@nuu.uz
ORCID 0000-0003-0108-8852

Nilufar U. Babakhanova
Tashkent State Transport University, Tashkent, Uzbekistan
lunalika1@mail.ru
ORCID 0000-0003-1973-1957

Elena G. Popkova
Armenian State University of Economics, Yerevan, Armenia
210471@mail.ru
ORCID 0000-0003-2136-2767

Aleksandra A. Musatkina
Togliatti State University, Togliatti, Russia
alamus13@yandex.ru
ORCID 0000-0002-6974-082X